Patent Claims

1. Device for determining and/or monitoring volume flow and/or mass flow of a medium (4) flowing through a pipeline (2) in a stream direction (S; Up), comprising: At least two ultrasonic transducers (5, 6), which emit ultrasonic measuring signals into the pipeline (2) and receive ultrasonic measuring signals from the pipeline (2); and a control/evaluation unit (11), which ascertains the volume- and/or mass-flow of the medium (4) in the pipeline (2) on the basis of the travel-time difference of the ultrasonic measuring signals in the stream direction (S; Up) and counter to the stream direction (Down); characterized in that

the control/evaluation unit (11) ascertains a plurality of sampled values (a_i with i = 1, 2, 3, ...) of a received measuring signal at defined points in time (t) of a predetermined time range;

the control/evaluation unit (11) interpolates the predetermined time range of the measuring signal by a continuous function (f(t)), wherein the continuous function (f(t)) is formed by a sum of a predetermined number (n $\in$ N) of wavelets (W) and wherein each wavelet (W) corresponds to the product of a sampled value with a sinc function ($\frac{\sin(x)}{x}$) and with a Gaussian bell curve

($e^{-\alpha x^2}$, α $\in$ R).

2. Device as claimed in claim 1,

characterized in that

the control/evaluation unit (11) determines between the sampled values at least one additional sampled value and approximates this additional sampled value, respectively these additional sampled values, by the continuous function, wherein the continuous function is formed by a sum of a predetermined number (n $\in$ N) of wavelets (W) and wherein each wavelet (W) corresponds to the product of a sampled value with a sinc function ($\frac{\sin(x)}{x}$) and with a Gaussian bell curve ($e^{-\alpha x^2}$, α $\in$ R).

3. Device as claimed in claim 1 or 2,

characterized in that

the control/evaluation unit (11) determines an abscissa value (t), at which an ordinate value of the continuous function (f(t)) reaches a predetermined limit value.

4. Device as claimed in claim 3,

characterized in that

the predetermined limit value of the continuous function (f(t)) is a zero point, a maximum, a minimum or an inflection point.

5. Device as claimed in claim 1,

characterized in that

the control/evaluation unit (11) determines an abscissa value (tmax, tmin) for a maximum and/or minimum on the basis of the first derivative f'(t) of the continuous function f(t).

6. Device as claimed in claim 1,

characterized in that

the control/evaluation unit (11) obtains an abscissa value (tmax), at which the continuous function reaches a maximum, by a linear interpolation of the first derivative of the continuous function (f(t)) according to the following formula, wherein t0 characterizes the abscissa value of a first approximation, at which a maximum or minimum is measured in the time interval (t0 - T, t0 + T), and wherein f''(t) represents the second derivative of the continuous function (f(t)):

$$t_{max} = t0 - \frac{f'(t0)}{f''(t0)}$$

7. Device as claimed in one or more of the preceding claims,

characterized in that

the control/evaluation unit (11) correlates, with one another, two ultrasonic measuring signals in two time ranges, interpolates the corresponding, discrete collection of correlation points by a continuous function (f(t)), and determines

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the abscissa value of the continuous function (f(t)), at which the ordinate value reaches a maximum value, wherein the abscissa value is a measure for a time shift between ultrasonic measuring signals sent and received in the stream direction (S, Up) and counter to the stream direction (Down).

8. Device as claimed in claim 1 or 2,
characterized in that
the calculating/control unit (11) determines by means of a mathematical simulation program, in each case, an optimum value for the coefficient (α) as a function of the number of measurement points (MaxSamplei).

9. Device as claimed in claim 8,
characterized in that
a memory unit (12) is provided, in which, in each case, the optimum value for the coefficient (α) is stored as a function of the number of measurement points (MaxSample).